

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 662005	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/JP00/04490	International filing date (day/month/year) 06/07/2000	Priority date (day/month/year) 08/07/1999
International Patent Classification (IPC) or national classification and IPC H05K3/30		
Applicant SUNSTAR GIKEN KABUSHIKI KAISHA		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application 		
Date of submission of the demand 29/01/2001	Date of completion of this report 17.09.2001	
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div> European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 </div> </div>	Authorized officer Bekkering, R Telephone No. +49 89 2399 2538	



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/JP00/04490

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):
- Description, pages:**

1-26 as originally filed

Claims, No.:

1-11 as originally filed

Drawings, sheets:

1/1 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/JP00/04490

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-4
	No:	Claims 5-11
Inventive step (IS)	Yes:	Claims
	No:	Claims 1-11
Industrial applicability (IA)	Yes:	Claims 1-11
	No:	Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

SECTION V:

Reference is made to the following documents:

D1: WO 98 31738 A (WIGHAM JON ;IIDA KAZUTOSHI (JP); LOCTITE CORP (US)) 23 July 1998 (1998-07-23) cited in the application

D2: EP-A-0 757 067 (SUNSTAR ENGINEERING INC) 5 February 1997 (1997-02-05)

D3: US-A-5 061 776 (LONG LYNN E ET AL) 29 October 1991 (1991-10-29)

From document D1 a mounted board is known from which the subject-matter of claim 1 only differs in that a different underfilling material is used which consists essentially of a one-pack type thermosetting urethane composition.

However, urethane compositions have already been employed for the same purpose. Reference is made to documents D2 and D3. It would therefore be obvious to the person skilled in the art, to apply these compositions with corresponding effects to the mounted board according to document D1 and thus arrive at the subject-matter of claim 1.

The subject-matter of independent claims 3 and 4 also lacks an inventive step in substance for the same reasons given above.

The subject-matter of independent claim 5 is fully anticipated by document D2 disclosing a one-pack type thermosetting urethane composition. The composition is suitable for use as underfilling material.

The additional features of dependent claims 2 and 6-10 are already known from document D2.

The subject-matter of independent claim 11 is fully anticipated by document D1 (cf., page 13, line 4 ff.) disclosing a method comprising heating to between 190 and 260 C

(i.e. between 180 and 350 C), melting the underfilling material and the solder, removing the package and mounting a package. The method is also suitable for repairing a mounted board with a urethane underfilling material discussed above, as would readily occur to the skilled person.

SECTION VII:

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D2 and D3 is not mentioned in the description, nor are these documents identified therein.

The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

SECTION VIII:

The different definitions of the invention given in independent claims 3 and 4 are such that the claims as a whole are not clear and concise, contrary to Article 6 PCT.

PCT REQUEST

662005

Original (for SUBMISSION) - printed on 04.07.2000 03:28:21 PM

0	For receiving Office use only	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.90 (updated 10.05.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Japanese Patent Office (RO/JP)
0-7	Applicant's or agent's file reference	662005
I	Title of invention	UNDERFILLING MATERIAL FOR SEMICONDUCTOR PACKAGE
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	Sunstar Giken Kabushiki Kaisha
II-5	Address:	7-1, Aketa-cho, Takatsuki-shi, Osaka 569-0806 Japan
II-6	State of nationality	JP
II-7	State of residence	JP
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	GOTOH, Johshi
III-1-5	Address:	22-2, Agenaruo-cho, Nishinomiya-shi, Hyogo 663-8186 Japan
III-1-6	State of nationality	JP
III-1-7	State of residence	JP



PCT REQUEST

662005

Original (for SUBMISSION) - printed on 04.07.2000 03:28:21 PM

III-2	Applicant and/or inventor	
III-2-1	This person is:	applicant and inventor
III-2-2	Applicant for	US only
III-2-4	Name (LAST, First)	OKUNO, Tatsuya
III-2-5	Address:	1590-4, Shimotoyama, Ritto-cho, Kurita-gun, Shiga 520-3011 Japan
III-2-6	State of nationality	JP
III-2-7	State of residence	JP
IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	AOYAMA, Tamotsu
IV-1-2	Address:	Aoyama & Partners IMP Building, 3-7, Shiromi 1-chome, Chuo-ku, Osaka-shi, Osaka 540-0001 Japan
IV-1-3	Telephone No.	06-6949-1261
IV-1-4	Facsimile No.	06-6949-0361
IV-2	Additional agent(s)	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	SHIBATA, Yasuo
V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	BR CN EE HU ID JP KR MX NO PL SG US VN
V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	

PCT REQUEST

3/4

Original (for SUBMISSION) - printed on 04.07.2000 03:28:21 PM

662005



V-6	Exclusion(s) from precautionary designations	NONE	
VI-1	Priority claim of earlier national application		
VI-1-1	Filing date	08 July 1999 (08.07.1999)	
VI-1-2	Number	Patent Applicaiton No. 11-194501	
VI-1-3	Country	JP	
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1	
VII-1	International Searching Authority Chosen	European Patent Office (EPO) (ISA/EP)	
VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	4	-
VIII-2	Description	26	-
VIII-3	Claims	4	-
VIII-4	Abstract	1	662005.txt
VIII-5	Drawings	1	-
VIII-7	TOTAL	36	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-9	Separate signed power of attorney	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-17	Other (specified):	Revenue stamps of transmittal fee for receiving office	-
VIII-17	Other (specified):	Certificate of payment of search fee for EPO	-
VIII-17	Other (specified):	Certificate of payment of basic & designation fee for International Bureau	-
VIII-18	Figure of the drawings which should accompany the abstract	Fig. 1	
VIII-19	Language of filing of the international application	English	
IX-1	Signature of applicant or agent		
IX-1-1	Name (LAST, First)	AOYAMA, Tamietsu	

FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	
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PCT REQUEST

662005

Original (for SUBMISSION) - printed on 04.07.2000 03:28:21 PM

10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	
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INTERNATIONAL SEARCH REPORT

Inter Application No
PCT/JP 00/04490

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05K3/30 H05K3/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H05K H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 31738 A (WIGHAM JON ;IIDA KAZUTOSHI (JP); LOCTITE CORP (US)) 23 July 1998 (1998-07-23) cited in the application the whole document	1-11
Y	EP 0 757 067 A (SUNSTAR ENGINEERING INC) 5 February 1997 (1997-02-05) the whole document	1-11
A	US 5 061 776 A (LONG LYNN E ET AL) 29 October 1991 (1991-10-29) the whole document	1-11

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

4 September 2000

Date of mailing of the international search report

12/09/2000

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.
Fax: (+31-70) 340-3016

Authorized officer

Bekkering, R

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/JP 00/04490

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>"SOLDER JOINT LIFE IMPROVEMENT USING ADHESIVE UNDER COMPONENT" RESEARCH DISCLOSURE, GB, INDUSTRIAL OPPORTUNITIES LTD. HAVANT, no. 309, 1990, page 32 XP000099320 ISSN: 0374-4353 the whole document</p>	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 00/04490

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9831738	A	23-07-1998	JP 10204259 A BR 9806743 A EP 0953008 A	04-08-1998 29-02-2000 03-11-1999
EP 0757067	A	05-02-1997	DE 69512397 D DE 69512397 T WO 9526374 A JP 2000117090 A US 5866668 A	28-10-1999 13-01-2000 05-10-1995 25-04-2000 02-02-1999
US 5061776	A	29-10-1991	IL 99610 A JP 4268317 A	26-08-1994 24-09-1992

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))



From the INTERNATIONAL BUREAU

To:

AOYAMA, Tamotsu
Aoyama & Partners
IMP Building
3-7, Shiromi 1-chome
Chuo-ku, Osaka-shi
Osaka 540-0001
JAPON

Date of mailing (day/month/year) 09 August 2000 (09.08.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 662005	International application No. PCT/JP00/04490

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

SUNSTAR GIKEN KABUSHIKI KAISHA (for all designated States except US)
GOTOH, Johshi et al (for US)

International filing date : 06 July 2000 (06.07.00)

Priority date(s) claimed : 08 July 1999 (08.07.99)

Date of receipt of the record copy
by the International Bureau : 21 July 2000 (21.07.00)

List of designated Offices :

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE
National : BR, CN, EE, HU, ID, JP, KR, MX, NO, PL, SG, US, VN


ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase
- ☒ confirmation of precautionary designations
- ☒ requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer:  Masashi HONDA Telephone No. (41-22) 338.83.38
--	--

PATENT COOPERATION TREATY

PCT



From the INTERNATIONAL BUREAU

**NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT**

(PCT Administrative Instructions, Section 411)

To:

AOYAMA, Tamotsu
Aoyama & Partners
IMP Building
3-7, Shiromi 1-chome
Chuo-ku, Osaka-shi
Osaka 540-0001
JAPON

Date of mailing (day/month/year) 16 November 2000 (16.11.00)	
Applicant's or agent's file reference 662005	IMPORTANT NOTIFICATION
International application No. PCT/JP00/04490	International filing date (day/month/year) 06 July 2000 (06.07.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 08 July 1999 (08.07.99)
Applicant SUNSTAR GIKEN KABUSHIKI KAISHA et al	

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
08 July 1999 (08.07.99)	11/194501	JP	25 Augu 2000 (25.08.00)

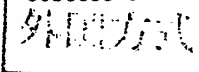
The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Sean Taylor

Telephone No. (41-22) 338.83.38



INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 00/04490

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05K3/30 H05K3/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H05K H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 31738 A (WIGHAM JON ; IIDA KAZUTOSHI (JP); LOCTITE CORP (US)) 23 July 1998 (1998-07-23) cited in the application the whole document	1-11
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A	US 5 061 776 A (LONG LYNN E ET AL) 29 October 1991 (1991-10-29) the whole document	1-11
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

4 September 2000

Date of mailing of the international search report

12/09/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Bekkering, R

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/JP 00/04490

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>"SOLDER JOINT LIFE IMPROVEMENT USING ADHESIVE UNDER COMPONENT" RESEARCH DISCLOSURE, GB, INDUSTRIAL OPPORTUNITIES LTD. HAVANT, no. 309, 1990, page 32 XP000099320 ISSN: 0374-4353 the whole document</p>	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 00/04490

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9831738	A	23-07-1998	JP 10204259 A	04-08-1998
			BR 9806743 A	29-02-2000
			EP 0953008 A	03-11-1999
EP 0757067	A	05-02-1997	DE 69512397 D	28-10-1999
			DE 69512397 T	13-01-2000
			WO 9526374 A	05-10-1995
			JP 2000117090 A	25-04-2000
			US 5866668 A	02-02-1999
US 5061776	A	29-10-1991	IL 99610 A	26-08-1994
			JP 4268317 A	24-09-1992

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

受付

13.4.23

山特許事務所


From the INTERNATIONAL BUREAU

To:

AOYAMA, Tamotsu
Aoyama & Partners
IMP Building
3-7, Shiromi 1-chome
Chuo-ku, Osaka-shi
Osaka 540-0001
JAPON

Date of mailing (day/month/year) 10 April 2001 (10.04.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 662005	
International application No. PCT/JP00/04490	International filing date (day/month/year) 06 July 2000 (06.07.00)

1. The following indications appeared on record concerning:	
<input checked="" type="checkbox"/> the applicant	<input type="checkbox"/> the inventor <input type="checkbox"/> the agent <input type="checkbox"/> the common representative
Name and Address	State of Nationality
	State of Residence
	Telephone No.
	Facsimile No.
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:	
<input checked="" type="checkbox"/> the person	<input type="checkbox"/> the name <input type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence
Name and Address	State of Nationality
	State of Residence
	Telephone No.
	Facsimile No.
3. Further observations, if necessary: The applicant identified in Box 2 should be included on the record as an additional applicant for all designated States except US.	
4. A copy of this notification has been sent to:	
<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  Masashi HONDA
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

WO 01/05203
PCT/JP00/04490

PCT



From the INTERNATIONAL BUREAU

NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

AOYAMA, Tamotsu
Aoyama & Partners
IMP Building
3-7, Shiromi 1-chome
Chuo-ku, Osaka-shi
Osaka 540-0001
JAPON

Date of mailing (day/month/year) 18 January 2001 (18.01.01)		IMPORTANT NOTICE	
Applicant's or agent's file reference 662005			
International application No. PCT/JP00/04490	International filing date (day/month/year) 06 July 2000 (06.07.00)	Priority date (day/month/year) 08 July 1999 (08.07.99)	
Applicant SUNSTAR GIKEN KABUSHIKI KAISHA et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
BR,CN,EE,EP,HU,ID,JP,MX,NO,PL,SG,VN

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
18 January 2001 (18.01.01) under No. WO 01/05203

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38
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PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 662005	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/JP 00/ 04490	International filing date (day/month/year) 06/07/2000	(Earliest) Priority Date (day/month/year) 08/07/1999
Applicant SUNSTAR GIKEN KABUSHIKI KAISHA		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 00/04490

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H05K3/30 H05K3/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H05K H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 31738 A (WIGHAM JON ; IIDA KAZUTOSHI (JP); LOCTITE CORP (US)) 23 July 1998 (1998-07-23) cited in the application the whole document ---	1-11
Y	EP 0 757 067 A (SUNSTAR ENGINEERING INC) 5 February 1997 (1997-02-05) the whole document ---	1-11
A	US 5 061 776 A (LONG LYNN E ET AL) 29 October 1991 (1991-10-29) the whole document --- -/--	1-11



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

4 September 2000

Date of mailing of the international search report

12/09/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Bekkering, R

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 00/04490

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A'	' "SOLDER JOINT LIFE IMPROVEMENT USING ADHESIVE UNDER COMPONENT" RESEARCH DISCLOSURE, GB, INDUSTRIAL OPPORTUNITIES LTD. HAVANT, no. 309, 1990, page 32 XP000099320 ISSN: 0374-4353 the whole document -----	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 00/04490

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9831738 A	23-07-1998	JP 10204259 A BR 9806743 A EP 0953008 A	04-08-1998 29-02-2000 03-11-1999
EP 0757067 A	05-02-1997	DE 69512397 D DE 69512397 T WO 9526374 A JP 2000117090 A US 5866668 A	28-10-1999 13-01-2000 05-10-1995 25-04-2000 02-02-1999
US 5061776 A	29-10-1991	IL 99610 A JP 4268317 A	26-08-1994 24-09-1992

H05K3/34B

H05K3/30



XP 000099320

4

30953

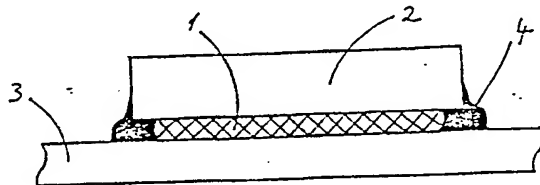
Solder Joint Life Improvement using Adhesive Under Component

p. 32

Disclosed is a method of increasing the solder joint life of leadless chip carriers (LCC's) soldered to organic circuit boards. High shear stresses developed during temperature cycling due to a mismatch in the thermal coefficient of expansion between the LCC and circuit board limit the life of the solder joints.

If the gap between the LCC and the circuit board is filled with a suitable adhesive, the shear stress at the solder joints will be reduced. This is the result of the adhesive mechanically coupling the lower modulus circuit board to the higher modulus LCC.

For example, polyurethane adhesive 1 is used between ceramic LCC 2 and epoxy/glass circuit board 3. The life of solder joints 4 were measured to be two to three times greater than for the case with no adhesive.



Disclosed anonymously

30953

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/05203 A1

(51) International Patent Classification⁷: H05K 3/30, 3/28

663-8186 (JP). OKUNO, Tatsuya [JP/JP]; 1590-4, Shimotoyama, Ritto-cho, Kurita-gun, Shiga 520-3011 (JP).

(21) International Application Number: PCT/JP00/04490

(22) International Filing Date: 6 July 2000 (06.07.2000)

(74) Agents: AOYAMA, Tamotsu et al.; Aoyama & Partners, IMP Building, 3-7, Shiromi 1-chome, Chuo-ku, Osaka-shi, Osaka 540-0001 (JP).

(25) Filing Language: English

(26) Publication Language: English

(81) Designated States (*national*): BR, CN, EE, HU, ID, JP, KR, MX, NO, PL, SG, US, VN.

(30) Priority Data:
11/194501 8 July 1999 (08.07.1999) JP

(84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

(71) Applicant (*for all designated States except US*): SUN-STAR GIKEN KABUSHIKI KAISHA [JP/JP]; 7-1, Aketa-cho, Takatsuki-shi, Osaka 569-0806 (JP).

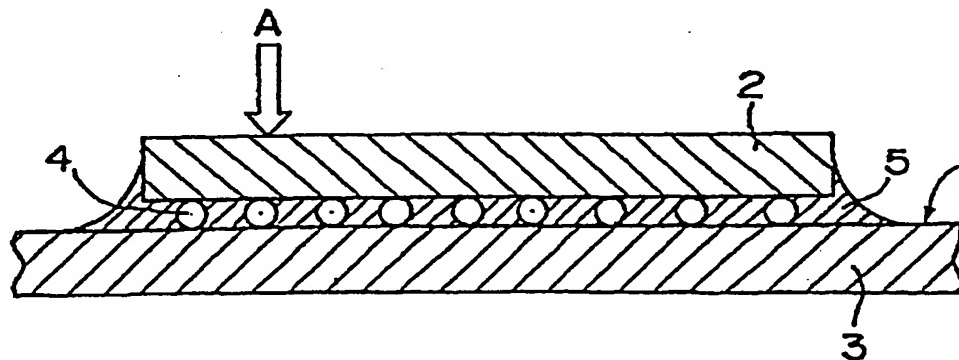
Published:
— With international search report.

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): GOTOH, Johshi [JP/JP]; 22-2, Agenaruo-cho, Nishinomiya-shi, Hyogo

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: UNDERFILLING MATERIAL FOR SEMICONDUCTOR PACKAGE



(57) Abstract: An underfilling material for a semiconductor package holding semiconductor elements on a carrier substrate mounted on a circuit board, containing a one-pack type thermosetting urethane composition which preferably comprises a urethane prepolymer having a terminal isocyanate group, which is obtained by reacting a polyol with an excessive amount of a polyisocyanate, and a fine powder-coated curing agent comprising a curing agent which is in a solid state at room temperature and surface active sites of which are covered with a fine powder. This composition can achieve both the low temperature curing properties and the storage stability.1

WO 01/05203 A1

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing (day/month/year) 30 March 2001 (30.03.01)	
International application No. PCT/JP00/04490	Applicant's or agent's file reference 662005
International filing date (day/month/year) 06 July 2000 (06.07.00)	Priority date (day/month/year) 08 July 1999 (08.07.99)
Applicant GOTOH, Johshi et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
29 January 2001 (29.01.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Kiwa Mpay

Telephone No.: (41-22) 338.83.38

10/019299

PATENT COOPERATION TREATY REC'D 17 JAN 2002

PCT

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 662005	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/JP00/04490	International filing date (day/month/year) 06/07/2000	Priority date (day/month/year) 08/07/1999
International Patent Classification (IPC) or national classification and IPC H05K3/30		
Applicant SUNSTAR GIKEN KABUSHIKI KAISHA		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 29/01/2001	Date of completion of this report 17.09.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Bekkering, R Telephone No. +49 89 2399 2538 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/JP00/04490

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-26 as originally filed

Claims, No.:

1-11 as originally filed

Drawings, sheets:

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/JP00/04490

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-4
	No: Claims 5-11
Inventive step (IS)	Yes: Claims
	No: Claims 1-11
Industrial applicability (IA)	Yes: Claims 1-11
	No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/JP00/04490

SECTION V:

Reference is made to the following documents:

- D1: WO 98 31738 A (WIGHAM JON ;IIDA KAZUTOSHI (JP); LOCTITE CORP (US)) 23 July 1998 (1998-07-23) cited in the application
- D2: EP-A-0 757 067 (SUNSTAR ENGINEERING INC) 5 February 1997 (1997-02-05)
- D3: US-A-5 061 776 (LONG LYNN E ET AL) 29 October 1991 (1991-10-29)

From document D1 a mounted board is known from which the subject-matter of claim 1 only differs in that a different underfilling material is used which consists essentially of a one-pack type thermosetting urethane composition.

However, urethane compositions have already been employed for the same purpose. Reference is made to documents D2 and D3. It would therefore be obvious to the person skilled in the art, to apply these compositions with corresponding effects to the mounted board according to document D1 and thus arrive at the subject-matter of claim 1.

The subject-matter of independent claims 3 and 4 also lacks an inventive step in substance for the same reasons given above.

The subject-matter of independent claim 5 is fully anticipated by document D2 disclosing a one-pack type thermosetting urethane composition. The composition is suitable for use as underfilling material.

The additional features of dependent claims 2 and 6-10 are already known from document D2.

The subject-matter of independent claim 11 is fully anticipated by document D1 (cf., page 13, line 4 ff.) disclosing a method comprising heating to between 190 and 260 C

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**International application No. **PCT/JP00/04490**

(i.e. between 180 and 350 C), melting the underfilling material and the solder, removing the package and mounting a package. The method is also suitable for repairing a mounted board with a urethane underfilling material discussed above, as would readily occur to the skilled person.

SECTION VII:

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D2 and D3 is not mentioned in the description, nor are these documents identified therein.

The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

SECTION VIII:

The different definitions of the invention given in independent claims 3 and 4 are such that the claims as a whole are not clear and concise, contrary to Article 6 PCT.

PCT

**NOTIFICATION OF THE RECORDING
 OF A CHANGE**

(PCT Rule 92bis.1 and
 Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

AOYAMA, Tamotsu
 Aoyama & Partners
 IMP Building
 3-7, Shiromi 1-chome
 Chuo-ku, Osaka-shi
 Osaka 540-0001
 JAPON

Date of mailing (day/month/year) 10 April 2001 (10.04.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 662005	
International application No. PCT/JP00/04490	International filing date (day/month/year) 06 July 2000 (06.07.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address UNI-SUNSTAR B.V. Strawinskylaan 3019 Atrium 1HG 1077 ZX Amsterdam Netherlands	State of Nationality NL	State of Residence NL
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

The applicant identified in Box 2 should be included on the record as an additional applicant for all designated States except US.

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☐ the International Searching Authority ☒ the elected Offices concerned
☒ the International Preliminary Examining Authority ☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Masashi HONDA Telephone No.: (41-22) 338.83.38
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35
(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/05203 A1

(51) International Patent Classification⁷: **H05K 3/30, 3/28**

663-8186 (JP). **OKUNO, Tatsuya** [JP/JP]; 1590-4, Shimotoyama, Ritto-cho, Kurita-gun, Shiga 520-3011 (JP).

(21) International Application Number: **PCT/JP00/04490**

(22) International Filing Date: **6 July 2000 (06.07.2000)**

(74) **Agents: AOYAMA, Tamotsu et al.**; Aoyama & Partners, IMP Building, 3-7, Shiromi 1-chome, Chuo-ku, Osaka-shi, Osaka 540-0001 (JP).

(25) Filing Language: **English**

(26) Publication Language: **English**

(81) **Designated States (national)**: BR, CN, EE, HU, ID, JP, KR, MX, NO, PL, SG, US, VN.

(30) **Priority Data**:
11/194501 8 July 1999 (08.07.1999) JP

(84) **Designated States (regional)**: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

(71) **Applicant (for all designated States except US)**: **SUN-STAR GIKEN KABUSHIKI KAISHA** [JP/JP]; 7-1, Aketa-cho, Takatsuki-shi, Osaka 569-0806 (JP).

Published:

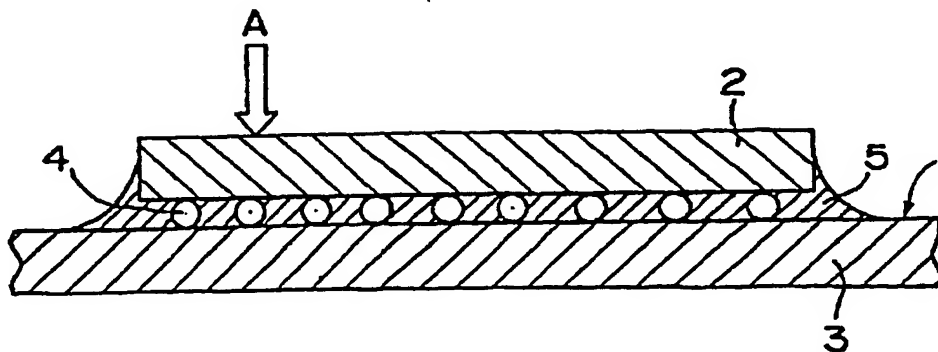
— With international search report.

(72) **Inventors; and**

(75) **Inventors/Applicants (for US only)**: **GOTOH, Johshi** [JP/JP]; 22-2, Agenaruo-cho, Nishinomiya-shi, Hyogo

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title: UNDERFILLING MATERIAL FOR SEMICONDUCTOR PACKAGE**



(57) **Abstract**: An underfilling material for a semiconductor package holding semiconductor elements on a carrier substrate mounted on a circuit board, containing a one-pack type thermosetting urethane composition which preferably comprises a urethane prepolymer having a terminal isocyanate group, which is obtained by reacting a polyol with an excessive amount of a polyisocyanate, and a fine powder-coated curing agent comprising a curing agent which is in a solid state at room temperature and surface active sites of which are covered with a fine powder. This composition can achieve both the low temperature curing properties and the storage stability.1

WO 01/05203 A1

DESCRIPTION

UNDERFILLING MATERIAL FOR SEMICONDUCTOR PACKAGE

FIELD OF THE INVENTION

5 The present invention relates to an underfilling material for semiconductor packages. In particular, the present invention relates to an underfilling material which is used when a semiconductor package holding semiconductor elements on a carrier substrate is mounted onto a circuit board, a mounted board produced
10 by such mounting, and a repairing method of a mounted board.

PRIOR ART

 The above-described type of the mounted board is used in applications requiring high reliance such as automobile equipment, computers, and the like, and also mobile phones which have been
15 mass-produced with the wide spread thereof. In general, such a mounted board is produced by mounting a semiconductor package holding semiconductor elements on a carrier substrate to a circuit board, that is, by bonding the semiconductor package onto the circuit board with solder balls.

20 In the case of mobile phones, bond-failure of the solder ball may occur by the deformation of the substrate caused by falling shock, external pressure generated with the operation of buttons, etc. Thus, a reinforcing method is employed by filling an underfilling material in spaces around the solder-bonded parts
25 and curing it to seal them. As the underfilling material used to improve the reliability of the connection by reinforcing, one-pack type or two-pack type thermosetting epoxy-based materials containing epoxy resins, curing agents and plasticizers

are widely and mainly used (cf. JP-A-10-204259).

However, the epoxy-based materials should be thermally cured for 30 minutes at 80°C or 10 minutes at 150°C. When the low temperature curing properties are enhanced by the adjustment of compositions, the epoxy-based materials should be stored at a low temperature of about 5°C or less. In addition, when the epoxy-based materials are used as the underfilling materials, and the connection failures are found, the cured products, which are bonded to the circuit board, should be removed one by one, by heat melting them and/or swelling them with solvents in the repairing works after detaching the semiconductor package from the circuit board. Therefore, the conventional epoxy-based materials do not have satisfactory repairing properties required at the work spot.

SUMMARY OF THE INVENTION

One object of the present invention is to provide an underfilling material for a semiconductor package, which can achieve both the low temperature curing properties and the storage stability, and solve the above problems in repairing, that is, an underfilling material which can be cured at a temperature of at least 60°C, for example, at 70°C for 20 minutes or at 80°C for 10 minutes, and can be stored at room temperature.

Another object of the present invention is to provide a novel mounted board comprising a semiconductor package holding semiconductor elements on a carrier substrate which is mounted on a circuit board.

A further object of the present invention is to provide a method for easily repairing a mounted board.

According to the first aspect of the present invention,

there is provided a mounted board comprising a circuit board and a semiconductor package holding semiconductor elements on a carrier substrate, wherein said semiconductor package is connected to said circuit board with solder balls, and spaces
5 between solder connected parts are filled with an underfilling material which consists essentially of a one-pack type thermosetting urethane composition.

According to the second aspect of the present invention, there is provide a method for producing a mounted board of the
10 present invention, comprising the steps of:

connecting said semiconductor board to said circuit board with said solder balls,

then filling the spaces between solder connected parts with said underfilling material, and

15 curing said underfilling material to seal said mounted board.

According to the third aspect of the present invention, there is provided a method for producing a mounted board of the present invention comprising the steps of:

20 applying the surface of said circuit board with said underfilling material,

connecting said semiconductor board to said circuit board with said solder balls,

and curing said underfilling material to seal said mounted
25 board.

According to the fourth aspect of the present invention, there is provide an underfilling material for a semiconductor package holding semiconductor elements on a carrier substrate

mounted on a circuit board, consisting essentially of a one-pack type thermosetting urethane composition.

According to the fifth aspect of the present invention, there is provided a method for repairing a mounted board of claim 1 comprising the steps of:

partly heating at least one of said semiconductor package and said circuit board to a temperature in the range between 180°C and 350°C,

melting said cured underfilling material and optionally said solder,

removing said semiconductor package from said circuit board and

mounting said semiconductor package or a new semiconductor package on said circuit board.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic cross section of the mounted board according to the present invention.

Fig. 2 is a schematic cross section of the mounted board of Fig. 1 after the semiconductor package is detached from the circuit board in the course of repairing.

DETAILED DESCRIPTION OF THE INVENTION

A typical example of a one-pack type thermally curable urethane composition to be used according to the present invention is a urethane composition comprising a urethane prepolymer having a terminal isocyanate group which is prepared by the reaction of a polyol with an excessive amount of polyisocyanate (hereinafter referred to as "NCO-containing prepolymer"), and a fine powder-coated curing agent comprising a curing agent which is in

a solid state at room temperature and the surface active sites of which are covered with a fine powder.

This urethane composition may contain any conventional additives such as plasticizers (e.g. ester plasticizers based on phthalic acid, isophthalic acid, adipic acid, azelaic acid, sebacic acid, maleic acid, fumaric acid, trimellitic acid, pyromellitic acid, phosphoric acid, sulfonic acid, etc.); adhesive promoters, for example, silane coupling agents (e.g. mercaptosilane, epoxysilane, vinylsilane, etc.), titanate coupling agents, aluminum coupling agents, epoxy resins, phenol resins, etc.; stabilizers (e.g. hindered phenol type, monophenol type, bis-trisphenol type, thiobisphenol type stabilizers, etc.); dehydrants (e.g. calcium oxide, zeolite, silica gel, etc.); dyes and pigments; and the like.

The viscosity of such a thermally curable urethane composition is usually adjusted in the range between 500 and 50,000 mPa.s, preferably between 1,000 and 20,000 mPa.s.

The NCO-containing prepolymer may be prepared by reacting a polyol and an excessive amount of a polyisocyanate. Usually, an equivalent ratio of NCO to OH is from 1.5:1 to 2.5:1, preferably from 1.9:1 to 2.2:1. The NCO-containing prepolymer has a molecular weight of 800 to 50,000, preferably 1,000 to 10,000.

Examples of the above polyol include polyetherpolyols (e.g. polyoxyalkylene polyol (PPG), modified polyetherpolyol, polytetraethylene ether glycol, etc.), polyesterpolyols (e.g. condensed polyesterpolyols, lactone-based polyesterpolyols, polycarbonatediols, etc.), polyols comprising backbones having C-C bonds (e.g. acrylicpolyols, polybutadiene polyols, polyolefine

polyols, castor oil, etc.), and the like.

Examples of the above polyisocyanate include tolylene diisocyanate (TDI), 4,4'-diphenylmethane diisocyanate, xylylene diisocyanate, hexamethylene diisocyanate, isophorone
5 diisocyanate, lysin diisocyanate, isopropylidenebis(4-cyclohexylisocyanate), hydrogenated xylylene diisocyanate, etc.

The NCO-containing prepolymer prepared using a polyetherpolyol as a polyol (PPG type prepolymer) or, in particular, a hydrocarbon polyol as a polyol (PH type prepolymer)
10 is advantageous, since it can impart electrical insulation to the material, but it may increase the viscosity of the material. Thus, the HC or PB type prepolymer is preferably used in combination with the NCO-containing prepolymer comprising PPG (PPG type prepolymer). In this case, a weight ratio of the HC or PB type
15 prepolymer to the PPG type prepolymer is usually from 9:1 to 2:8, preferably from 9:1 to 5:5. Furthermore, a NCO-containing prepolymer, which is prepared by reacting a mixture of the PB type polyol and PPG in a specific ration with an excessive amount of a polyisocyanate, may be used.

20 The fine powder coated curing agent may be prepared with a shear-friction mixing system by grinding the curing agent which is in the solid state at room temperature to a median particle size of 20 μm or less while adding thereto the fine powder in a weight ratio of the curing agent to the fine powder in the range
25 between 1:0.001 to 1:0.7, preferably between 1:0.01 to 1:0.5, and mixing and grinding them so that the median particle size of the fine powder becomes 2 μm or less, whereby the fine powder is adhered to the surface of the particles of the solid curing agent.

Alternatively, the fine powder-coated curing agent may be prepared by mixing the finely preground solid curing agent and the fine powder with a high speed impact type mixer (e.g. jet mill) or a compression shear type mixer. The use of the high speed impact
5 type mixer is preferable.

Examples of the curing agent which is in the solid state at room temperature include imidazole compounds (e.g. imidazole, 2-methylimidazole, 2-ethylimidazole, 2-ethyl-4-methylimidazole, 2-isopropylimidazole, 2-phenyl-imidazole, 2-dodecylimidazole,
10 2-undecylimidazole, 2-heptadecyl imidazole, their salts with carboxylic acids such as acetic acid, lactic acid, salicylic acid, benzoic acid, adipic acid, phthalic acid, citric acid, tartaric acid, maleic acid, trimellitic acid, etc.); imidazoline compounds (e.g. 2-methylimidazoline, 2-phenylimidazoline, 2-
15 undecylimidazoline, 2-heptadecylimidazoline, 1-(2-hydroxy-3-phenoxypropyl)-2-phenylimidazoline, 1-(2-hydroxy-3-butoxypropyl)-2-methylimidazoline, etc.); aromatic amine compounds (e.g. 4,4'-, 2,4'-, 3,3'- or 3,4'-diaminodiphenylmethane, 2,2'- 2,4'- or 3,3'-diaminobiphenyl,
20 2,4- or 2,5-diaminophenol, o- or m-phenylenediamine, 2,3-, 2,4-2,5-, 2,6- or 3,4-tolylenediamine, etc.); aliphatic amine compounds (e.g. 1,8-octanediamine, 1,10-decanediamine, 1,12-dodecanediamine, 1,14-tetradecanediamine, 1,16-hexadecanediamine, etc.); guanidine compounds (e.g.
25 dicyanodiamine, etc.); acid anhydrides (e.g. phthalic anhydride, tetrahydrophthalic anhydride, hexahydrophthalic anhydride, methylated hexahydrophthalic anhydride, trimellitic anhydride, etc.); dibasic carboxylic acid dihydrazide (e.g. adipic acid

dihydrazide, sebacic acid dihydrazide, etc.); guanamines (e.g. benzoguanamine, etc.); melamine; amine adducts (e.g. adducts of 2-ethyl-4-methylimidazole and bisphenol A epoxy resins, etc.); and the like.

5 Examples of the fine powder include inorganic powders (e.g. titanium oxide, calcium carbonate, clay, silica, zirconia, carbon, alumina, talc, etc.); and organic powder (e.g. polyvinyl chloride, acrylic resins, polystyrene, polyethylene, etc.); and the like.

 When the solid curing agent and the fine powder are mixed
10 and ground, static electricity may be generated and thus the fine powder may be adhered to the surfaces of the particles of the solid curing agent, or the particles of the solid curing agent may be partially molten with a heat due to friction, impact or compression shear generated with the mixer and thus the fine powder is adhered
15 to the surfaces of the particles of the solid curing agent, or the fine powder may be physically anchored in the surfaces of the particles of the solid curing agent, or the surfaces of the particles of the solid curing agent may be chemically activated and thus the fine powder may be adhered to the surfaces of the
20 particles of the solid curing agent. Accordingly, the active groups such as $-NH_2$ or $-NH$ groups on the surfaces of the particles of the solid curing agent can be coated with the fine powder.

 The fine powder-coated curing agent can be activated by heating at a temperature equal to or higher than the melting point
25 of the solid curing agent, and therefore, the active groups, which are reactivated by heating, contribute to the curing reaction with the NCO groups of the NCO-containing prepolymer.

 The amount of the fine powder-coated curing agent may be

selected so that the curing agent is present in substantially an equivalent amount to the NCO-containing prepolymer.

Another example of the one-pack type thermally curable urethane composition includes a polyisocyanate the NCO group of which is inactivated with a blocking agent (e.g. phenol type, oxime type or lactam type blocking agents), or a combination of an inactivated polyisocyanate, which is in the solid state at room temperature, with a curing agent (e.g. polyols, polyamines, etc.). The polyisocyanate may be that used in the above preparation of the NCO-containing prepolymer.

Furthermore, a combination of a polyisocyanate with a inactivated polyamine curing agent.

Preferably, the one-pack type thermally curable urethane composition of the present invention may further contain an epoxy resin, an organosilicone and/or a dehydrant.

The epoxy resin increases the physical properties of the cured product of the urethane composition of the present invention.

The amount of the epoxy resin may be from 5 to 30 wt. %, preferably from 7 to 20 wt. %, based on the weight of the urethane composition.

When the amount of the epoxy resin is less than 5 wt. %, the physical properties of the urethane composition of the present invention may not be improved. When the amount of the epoxy resin exceeds 30 wt. %, the viscosity of the urethane composition of the present invention tends to increase so that the workability and penetrability deteriorate.

The epoxy resin may be any conventionally used epoxy resin.

Specific examples of the epoxy resin include the following ones:

(1) Glycidylamine epoxy resins

Epoxy resins having at least one N,N-diglycidylamino group, such as N,N,N',N'-tetraglycidylaminodiphenylmethane, N,N-
5 diglycidyl-m- or p-aminophenol glycidyl ether and their condensates. They are commercially sold under ARALDITE® MY 720 (available from Ciba-Geigy), and EPOTOTE® 434 and YH 120 (both available from TOTO KASEI KABUSHIKI KAISHA).

(2) Novolak epoxy resins

10 Phenolic novolak epoxy resins such as EPIKOTE® 152 and 152 (both available from Shell Chemical), DOW EPOXY RESIN DEN 431, 438, 439 and 485 (all available from Dow Chemical), RE-3055 (available from NIPPON KAYAKU), etc. Cresol novolak epoxy resins such as ECN 1235, 1273, 1280 and 1299 (all available from
15 Ciba-Geigy), EOCN 100, 102, 103 and 104 and EOCN-1020, 1025, 1027 3300 and 4400 (all available from NIPPON KAYAKU), QUATREX 3310, 3410 and 3710 (all available from Dow Chemical), etc.

(3) Bisphenol A epoxy resins

Bisphenol A epoxy resins such as EPIKOTE® 828, 834, 827,
20 1001, 1002, 1004, 1007 and 1009 (all available from YUKA SHELL), DOW EPOXY DER 331, 332, 662, 663U and 662U (all available from Dow Chemical), ARALDITE® 6071, 7071 and 7072 (all available from Ciba-Geigy), EPICRONE 840, 850, 855, 860, 1050, 3050, 4050 and 7050 (all available from DAINIPPON INK AND CHEMICALS), RE-310S
25 and RE-410S (both available from NIPPON KAYAKU), etc.

Urethane-modified bisphenol A epoxy resins such as ADEKA RESIN EPV-6, EPV-9 and EPV-15 (all available from ASAHI DENKA KOGYO), etc. Brominated bisphenol A epoxy resins such as ARALDITE® 8011

(available from Ciba-Geigy), DOW EPOXY RESIN DER 511 (available from Dow Chemical), etc.

(4) Alicyclic epoxy resins

ARALDITE® CY-179, CY-178, CY-182 and CY-183 (all available from Ciba-Geigy).

(5) Other epoxy resins

Bisphenol F epoxy resins such as EPIKOTE® 807 (available from YUKA SHELL), RE-304S, RE-403S and RE-404S (all available from NIPPON KAYAKU), S-129 and 830S (both available from DAINIPON INK AND CHEMICALS). Resorcinol epoxy resins, tetrahydroxyphenylethane epoxy resins, polyalcohol epoxy resins, polyglycol epoxy resins, glyceroltriether epoxy resins, polyolefin epoxy resins, epoxidized soybean oil, ester epoxy resins, phenolic epoxy resins, naphthalene epoxy resins, flame-retarded epoxy resins, and the like.

Among the above epoxy resins, the epoxy resins which are in the liquid state at room temperature, can be used as such, while those which are in the solid state at room temperature may be heated to their melting points and molten, or solved by the co-use of the liquid epoxy resins.

The organosilicone compound can improve the adhesion properties and wettability. The organosilicone compound may be at least one compound selected from the group consisting of silane coupling agents, organopolysilicones having terminal silanol groups, polyether-modified silicones and modified organosilicones.

The amount of the organosilicone compound is usually from 0.01 to 5.0 wt. %, preferably from 0.05 to 5.0 wt. %, based on

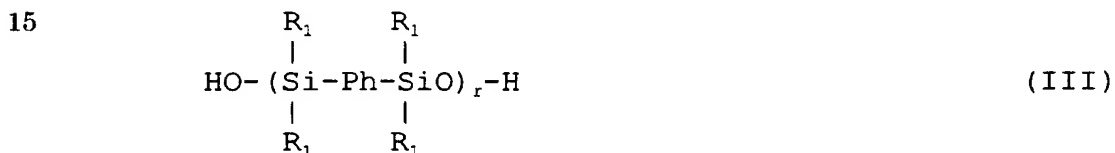
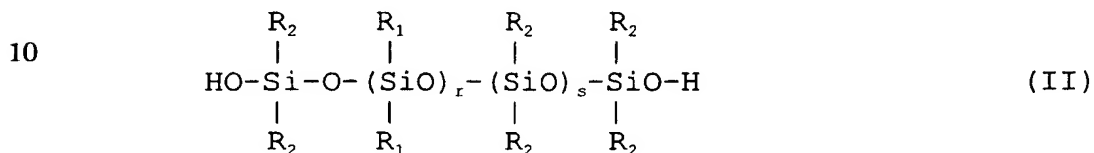
the weight of the urethane composition.

When the amount of the organosilicone compound is less than 0.01 wt. %, the adhesion properties and penetrability of the urethane composition of the present invention may not be improved.

5 When the amount of the organosilicone compound exceeds 5 wt. %, the storage stability of the urethane composition of the present invention tends to deteriorate.

Examples of the silane coupling agent include aminosilane compounds (e.g. γ -aminopropyltriethoxysilane, β -aminoethyl-
10 trimethoxysilane, γ -aminopropyldiethoxysilane, γ -allylaminopropyltrimethoxysilane, β -(β -aminoethylthioethyl)-diethoxymethylsilane, β -(β -aminoethylthioethyl)triethoxysilane, β -phenylaminopropyltrimethoxysilane, γ -cyclohexylaminopropyl-
trimethoxysilane, γ -benzylaminopropyltrimethoxysilane, γ -
15 (vinylbenzylaminopropyl)triethoxysilane, N- β -(aminoethyl)- γ -aminopropyltrimethoxysilane, N- β -(aminoethyl)- γ -aminopropylmethyldimethoxysilane, β -aminoethylaminomethylmethoxysilane, γ -[β -(β -aminoethylaminoethylamino)propyl]triethoxysilane, N-(3-triethoxysilylpropyl)urea, etc.), mercaptosilane compounds
20 (e.g. 3-mercaptopropylmethyldimethoxysilane, 3-mercaptopropyltriethoxysilane, mercaptomethyltrimethoxysilane, 3-mercaptopropyltrimethoxysilane, etc.), epoxysilane compounds (e.g. β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane, [2-(3,4-epoxy-4-methylcyclohexyl)propyl]methyldiethoxysilane, (3-
25 glycidoxypropyl)methyldiethoxysilane, 3-glycidoxypropyltrimethoxysilane, etc.), isocyanate silane compounds (e.g. γ -isocyanatepropyltriethoxysilane, γ -isocyanatepropyltrimethoxysilane, etc.), and the like.

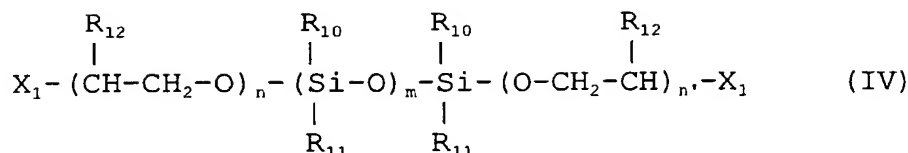
Examples of the silanol organopolysilicones having the terminal silanol groups include polysiloxanes of the formulas:



wherein R_1 is a methyl group or a phenyl group, R_2 is a phenyl group, Ph is a para-phenylene group, r is a number of 9 to 500, and s is 0 or a number of 6 % or less of r . They may be used singly or in admixture of two or more.

Specific examples of the commercially available organopolysilicones having the terminal silanol groups are polydimethylsiloxane having terminal silanol groups, diphenylsiloxane having terminal silanol groups, polydimethyldiphenylsiloxane having terminal silanol groups, polytetramethyl-p-silylphenylenesiloxane, etc.

One example of the polyether-modified silicone is a compound of the formula:



5

wherein X_1 is $-OH$, $-NH_2$ or $-NHR$ in which R is a linear or branched alkyl group having 1 to 8 carbon atoms or a phenyl group; R_{10} and R_{11} are the same or different and each a hydrogen atom, a methyl group or a phenyl group; R_{12} is a hydrogen atom or a methyl group; 10 m is a number of 3 to 300; n is a number of 1 to 100; and n' is a number of 1 to 100.

One example of the modified organosilicone is an organosilicone prepared by reacting (a) a silicone compound having active hydrogen atoms at both ends, (b) a polyhydric active 15 hydrogen compound, (c) a diisocyanate compound and (d) a chain extender having active hydrogen atoms at both ends according to one of the following methods:

(i) First method:

Firstly the silicone compound having the active hydrogen 20 atoms at both ends (a) is reacted with the diisocyanate compound (c) at a temperature of 20 to 120°C for 10 minutes to 120 hours, optionally in the presence of a solvent to form a mono-adduct.

Examples of the solvent include ethyl acetate, butyl acetate, toluene, xylene, acetone, methyl ethyl ketone, methyl isobutyl 25 ketone, tetrahydrofuran, etc.

Separately, the polyhydric active hydrogen compound (b) and the diisocyanate compound (c) are reacted under the same conditions as those in the above reaction to form another mono-adduct.

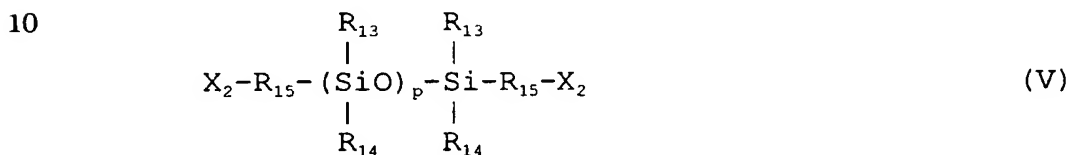
30 Then, the both mono-adducts are block addition reacted in

the presence of the chain extender having the active hydrogen atoms at both ends (d) at a temperature of 20 to 120°C for 1 to 120 hours to obtain a urethane-modified silicone resin.

(ii) Second method:

5 The above four components (a) to (d) are block addition reacted in a one-batch system optionally in the presence of the above solvent to obtain a urethane-modified silicone resin.

One example of the silicon compound having the active hydrogen at the both ends (a) is a compound of the formula:

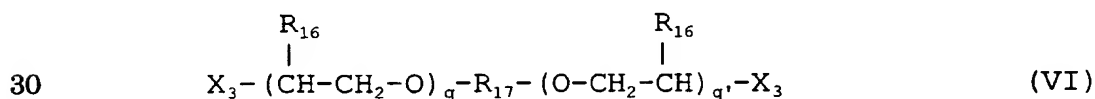


15 wherein X₂ is -OH, -NH₂ or -NHR in which R is the same as defined above; R₁₃ and R₁₄ are the same or different and each a hydrogen atom, a methyl group or a phenyl group, R₁₅ is an alkylene or alkylene ether group having 1 to 12 carbon atoms; and p is a number of 3 to 300.

20 The silicone compound (V) has a molecular weight of 900 to 20,000, preferably 1,800 to 10,000.

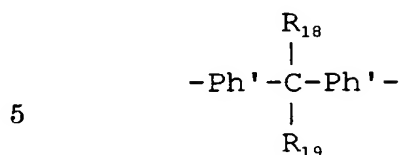
Such silicone compounds are commercially sold under the trade names KF 6001, KF6002 and KF 6003 (all available from Shin-Etsu Silicone), FM3311, FM3321 and FM4421 (all available from
25 CHISSO), etc.

Examples of the polyhydric active hydrogen compound (b) include



30 wherein X₃ is -OH, -NH₂ or -NHR in which R is the same as defined above; R₁₆ is a hydrogen atom or a methyl group; R₁₇ is an alkylene

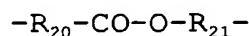
group havng 1 to 12 carbon atoms or a group of the formula:



wherein R_{18} and R_{19} are the same or different and each a hydrogen atom or a methyl group, and Ph' is an o-, m- or p-phenylene group which may be hydrogenated; q is a number of 1 to 100; and q' is a number of 1 to 100

(e.g. polypropylene glycol, polyethylene glycol, polypropyleneethylene glycol, propylene and/or ethylene adducts of bisphenol A),

or a polyesterpolyol with hydroxyl groups at both ends comprising repeating units of the formula:



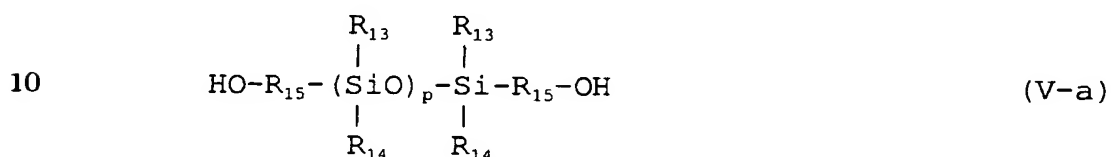
wherein R_{20} is a residue of an aliphatic or aromatic dicarboxylic acid; and R_{21} is a residue of an aliphatic or aromatic dihydric alcohol, provided that R_{20} and/or R_{21} may be the same in all the repeating units or different from the repeating units to the repeating units to provide a copolymer.

The molecular weight of the polyhydric active hydrogen compound (b) may be from 500 to 10,000, preferably from 1,000 to 3,000.

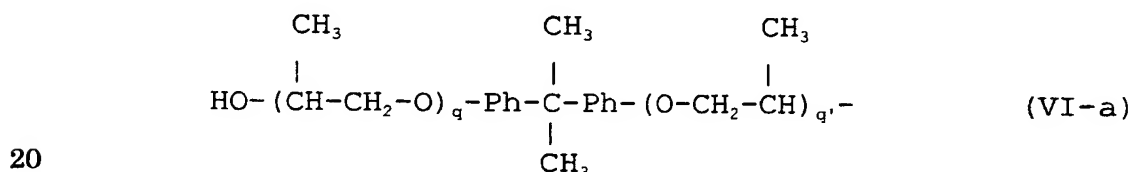
Examples of the diisocyanate compound (c) include aromatic diisocyanates (e.g. 2,4- or 2,6-tolylene diisocyanate (TDI), 4,4'-diphenylmethane diisocyanate (MDI), xylylene diisocyanate, etc.), and aliphatic diisocyanates (e.g. hexamethylene diisocyanate, lysin diisocyanate, isophorone diisocyanate, hydrogenated MDI, hydrogenated TDI, etc.).

Examples of the chain extender having the active hydrogen atoms at the both ends (d) include ethylene glycol, propylene glycol, butanediol, dimethylolcyclohexane, methyliminodiethanol, dimethylolpropionic acid, ethylenediamine, hexamethylenediamine, etc.

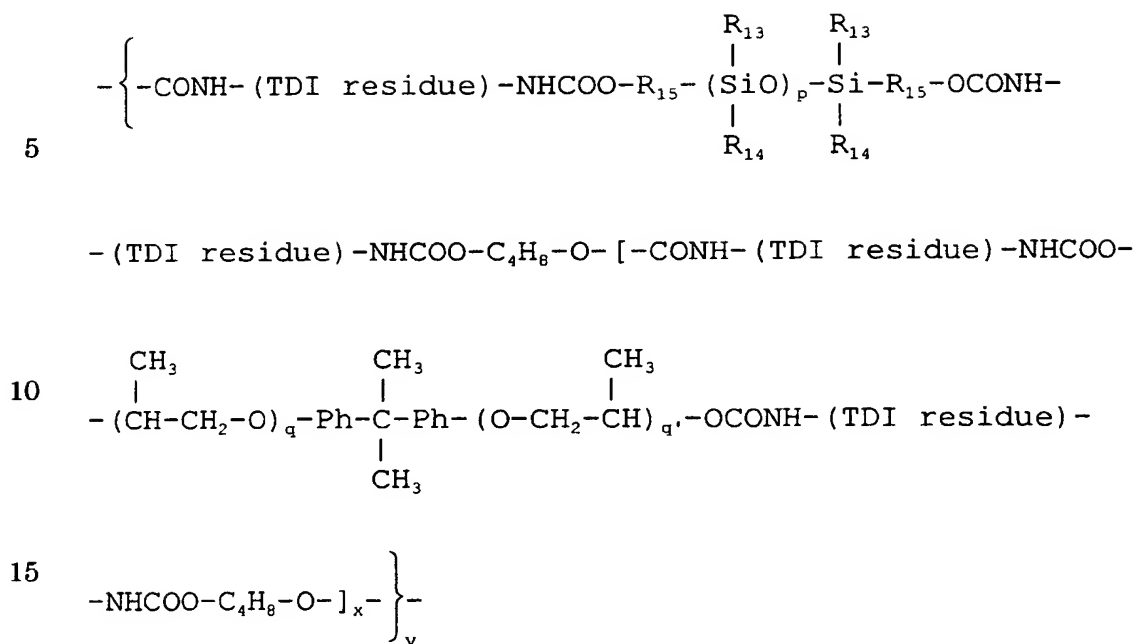
When a silicone compound having active hydrogen atoms at both ends of the formula:



wherein R_{13} , R_{14} , R_{15} and p are the same as defined above is used as the component (a), a bisphenol A-propylene oxide adduct of the formula:



wherein q and q' are the same as defined above and Ph is a para-phenylene group is used as the component (b), TDI is used as the component (c), and butanediol is used as the component (d), the modified organosilicone has a chemical structure of the formula:



wherein R_{13} , R_{14} , R_{15} , p , q , q' and Ph are the same as defined above,
 20 and x is a number 1 to 10 and y is a number of 1 to 20.

A dehydrant can improve the storage stability of the urethane composition of the present invention. The amount of the dehydrant is 1 to 10 wt. %, preferably 2 to 5 wt. %, based on the weight of the urethane composition.

25 Examples of the dehydrant include calcium oxide, zeolite, silica gel, ethyl silicate, ethyl orthophosphate, ethyl formate, methyl orthoacetate, etc.

The one-pack type thermally curable urethane composition of the present invention may contain any conventional additives,
 30 if desired. Examples of the additives include extenders, reinforcing agents, fillers (e.g. coal tar, glass fiber, boron fiber, carbon fiber, cellulose, polyethylene powder, polypropylene powder, quartz powder, mineral silicates, mica, slate powder, kaolin, aluminum oxide trihydrate, aluminum

hydroxide, chalk powder, gypsum, calcium carbonate, antimony trioxide, bentonite, silica, aerosil, lithopone, barite, titanium dioxide, carbon black, graphite, iron oxide, gold powder, aluminum powder, iron powder, etc.), pigments, organic solvents (e.g. toluene, xylene, methyl ethyl ketone, methyl isobutyl ketone, ethyl acetate, butyl acetate, etc.), reactive diluents (e.g. butyl glycidyl ether, N,N'-diglycidyl-o-toluidine, phenyl glycidyl ether, styrene oxide, ethylene glycol diglycidyl ether, propylene glycol diglycidyl ether, 1,6-hexanediol diglycidyl ether, etc.), non-reactive diluents (e.g. dioctyl phthalate, dibutyl phthalate, dioctyl adipate, petroleum solvents, etc.), modified epoxy resins (e.g. urethane-modified epoxy resins, alkyd-modified epoxy resins, etc.), and the like.

The mounted board according to the present invention may be produced by any conventional methods which are employed to produce the conventional mounted boards, except that the one-pack type thermosetting urethane composition of the present invention is used as the underfilling material for the semiconductor package.

Now, one preferred embodiment of the method for the production of the mounted board according to the present invention will be explained by making reference to Fig. 1.

As shown in Fig. 1, the mounted board 1 is produced by connecting the semiconductor package 2 to the circuit board 3 with solder balls 4 each having a diameter of 300 to 800 μm at a ball pitch of 100 to 500 μm , filling the spaces between the solder balls 4 with the underfilling material 5, that is, the one-pack type thermosetting urethane composition of the present invention,

using a precisely metering/discharging apparatus for liquids, and then heating the mounted board at a temperature of 80 to 100°C for 5 to 10 minutes to cure the urethane composition and seal the spaces.

5 The circuit board may be made of a resin such as a glass-reinforced epoxy resin, an ABS resin, a phenol resin, etc.

 The semiconductor package may be produced holding semiconductor elements (e.g. LSI, etc.) on a carrier substrate, that is, electrically connecting the semiconductor elements and
10 the carrier substrate with a high-melting solder, an anisotropic conductive adhesive or a wire, and sealing them with a suitable resin to increase the reliability and durability of the connections. The carrier substrate may be a substrate or a tape made of a ceramic such as Al_2O_3 , SiN_3 , $\text{Al}_2\text{O}_3/\text{SiO}_2$, or a heat-resistant
15 resin such as a polyimide resin, or the resin used to produce the above circuit board.

 Examples of the semiconductor package are chip size packages (CSP), ball grip arrays (BGA), and so on.

 If poor connection is found in the mounted board, it can
20 be repaired by the following procedures:

 i) First, as shown in Fig. 1, a part of the upper surface of the semiconductor package 2 is heated with hot air A to a temperature of 180 to 300°C to melt the solder balls 4 in the soldered area, and the semiconductor package 2 is detached (see
25 Fig. 2).

 ii) Then, one end of the composite 6 of the remaining underfilling material 5' and the remaining solder balls 4' is pinched with a forceps or any other tool (not shown), and the

composite 6 is easily peeled off from the circuit board 3, while a hot air is blown on the lower surface of the circuit board 3 to heat it to a temperature of 180 to 350°C, preferably 200 to 300°C.

- 5 After cleaning the surface of the circuit board 3, the semiconductor package is again mounted by the above procedures.

EXAMPLES

The present invention will be illustrated in detail by the following Examples.

10 Examples 1 - 4

(1) Synthesis of a NCO-containing prepolymer

A polybutadiene based polyol and TDI were reacted with the NCO/OH ratio being 2.0 to obtain a NCO-containing prepolymer having a molecular weight of 1,500 (PH-based prepolymer).

15 (2) Fine powder-coated curing agent

1,10-Decanediamine (melting point: 60°C) and titanium oxide having a median particle size of 0.27 μm were mixed in a weight ratio of 1:0.3, and ground with a jet mill to obtain a fine powder-coated curing agent having a median particle size of 10 μm .

(3) Preparation of a one-pack type thermosetting urethane composition

i) Firstly, a NCO-containing prepolymer prepared from PPG and TDI (SUNPRENE SEL No. 3 available from SANYO KASEI; NCO content of 3.6 %; molecular weight of 7,000) (hereinafter referred to as "PPG-based prepolymer") and the NCO-containing prepolymer prepared in the above (1) (PH-based prepolymer) were mixed in a weight ratio shown in Table 1, and cured at 80°C for 10 minutes.

Then, the physical properties (with the JIS No. 3 dumbbell shaped sample) and electrical properties of the cured product were measured. The results are shown in Table 1.

Table 1

Run No.	1	2	3	4	5	6	7
Weight ratio of PPG-based prepolymer to PH-based prepolymer	100/0	90/10	70/30	50/50	30/70	10/90	0/100
Physical property							
-50 % modulus (kg/cm ²)	16.5	20.0	19.3	25.5	48.7	59.5	52.9
-strength at break (%)	38.7	40.3	43.9	53.4	90.9	78.5	57.5
-Maximum elongation (%)	400	350	200	200	200	125	100
Electrical property							
-Dielectric constant (ϵ)	--	--	4.97	4.61	4.23	3.7	3
-Dielectric dissipation factor (tan δ)	--	--	0.0575	0.0428	0.04	0.0188	0.015
-Volume resistivity ($\Omega \cdot \text{cm}$)	$1.0 \times 10^8 >$	$1.0 \times 10^8 >$	2.70×10^{10}	8.70×10^{10}	1.29×10^{12}	2.95×10^{13}	6.61×10^{16}

ii) Next, the mixed prepolymer No. 7 prepared in the above step i) (weight ratio of PPG-based prepolymer to PH-based prepolymer = 30/70), the fine powder-coated curing agent prepared in (2), a plasticizer, a bisphenol A epoxy resin, a silane coupling agent, polydimethylsiloxane, a stabilizer and a dehydrant were homogeneously mixed in amounts (wt. parts) of Table 2 to obtain a one-pack type thermosetting urethane composition having a viscosity shown in Table 2 (at 23°C).

(4) Performance tests

The prepared composition was subjected to the following tests:

(a) Low temperature curing properties

A heating condition required for curing was measured when the composition was applied in a thickness of 2 mm on a steel plate. The steel plate was heated in an oven heated with hot air.

(b) Adhesion strength

Tensile shear adhesion strength was measured according to JIS K 6850 using a glass-reinforced epoxy resin as a test piece.

(c) Penetrating properties

A time was measured, in which the urethane composition advanced in a gap of 500 μm between a pair of glass plates for a distance of 10 mm at 40°C by the capillary action.

(d) Volume resistivity ($\Omega \cdot \text{cm}$)

According to JIS K 6911, a volume resistivity of the urethane composition was measured after keeping the composition at 23°C for 1 minutes while applying a voltage of 100 V.

(e) Repairing properties

A urethane composition was applied at a thickness of 500

µm on a glass-reinforced epoxy resin plate and cured at 80°C for 20 minutes. Then, the coated plate was placed on a hot plate, and the coated urethane composition was peeled off at a hot plate surface temperature of 210°C, 220°C and 230°C. The repairing
5 properties were evaluated by the peeling condition of the coated urethane composition, and ranked according to the following criteria:

- A: Completely removed in the peeled state
- B: Almost all the cured urethane composition removed
- 10 C: Splits remain on the circuit board
- D: Repairing impossible

(f) Storage stability

The urethane composition was stored at 40°C for 2 months and the viscosity of the composition was measured. Then, the
15 increase (%) of the viscosity in comparison with the viscosity before storage was calculated.

In Comparative Example 1, the urethane composition was stored only one day, and then the viscosity was measured.

The results are shown in Table 2.

20 Comparative Example 1

The one-pack type thermosetting epoxy material (PENGUIN CEMENT 1090 available from SUNSTAR GIKEN) was used and subjected to the same performance tests as in Examples 1 to 4.

The results are shown in Table 2.

Table 2

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	C. Ex. 1
Mixed prepolymer	50	50	40	40	
Curing agent	13.5	13.5	15	15	
Plasticizer ¹⁾	30	30	25	25	
Epoxy resin ²⁾			20	20	
Silane	2.5				
Coupling agent ³⁾					
Polydimethyl-Siloxane ⁴⁾		2.5	2.5	2.5	
Stabilizer ⁵⁾	0.1	0.1	0.1	0.1	
Dehydrant				3	
Viscosity (mPa.s)	8000	6600	5200	4900	5600
Low temperature Curing properties	80°C x 10min.	80°C x 10min.	80°C x 10min.	80°C x 10min.	130°C x 10min.
Adhesion strength (N/mm ²)	5.0	6.0	8.5	8.5	15.2
Penetrating Properties (sec.)	50	45	40	40	40
Volume resistivity ($\Omega \cdot \text{cm}$)	1.5 x 10 ¹²	4.5 x 10 ¹³	5.0 x 10 ¹³	5.5 x 10 ¹³	1.0 x 10 ¹⁶
Repairing Properties					
-180°C	C	C	C	C	D
-220°C	B	B	B	B	D
-230°C	A	A	A	A	D
Storage stability (viscosity increase: %)	49	45	Not measurable	25	50

Notes:

- 1) Tri(2-ethylhexyl) trimellitate + di(2-ethylhexyl) adipate in a weight ratio of 2:1.
- 5 2) Bisphenol A epoxy resin (EPIKOTE[®] 828 available from YUKA SHELL).
- 3) 3-Glycidoxypropyltrimethoxy silane (KBM-351A (trade name) available from Shin-Etsu Chemical).
- 4) Polyether-modified silicone (KF-351A (trade name) available from Shin-Etsu Chemical).
- 10 5) Tetrakis[methylene-3-(3',5'-di-tert.-butyl-4'-hydroxy-phenyl)propionate]methane (ADEKA STUB AO-60 available from ASAHI DENKA KOGYO).

As can be seen from the results of Table 2, the urethane compositions of the present invention have better low temperature curing properties and storage stability than the conventional urethane material.

CLAIMS

1. A mounted board comprising a circuit board and a semiconductor package holding semiconductor elements on a carrier substrate, wherein said semiconductor package is
5 connected to said circuit board with solder balls, and spaces between solder connected parts are filled with an underfilling material which consists essentially of a one-pack type thermosetting urethane composition.

2. The mounted board according to claim 1, wherein said
10 one-pack type thermosetting urethane composition comprises:

a urethane prepolymer having a terminal isocyanate group, which is obtained by reacting a polyol with an excessive amount of a polyisocyanate, and

a fine powder-coated curing agent comprising a curing agent
15 which is in a solid state at room temperature and surface active sites of which are covered with a fine powder.

3. A method for producing a mounted board which comprises a circuit board and a semiconductor package holding semiconductor elements on a carrier substrate, wherein said
20 semiconductor package is connected to said circuit board with solder balls, and spaces between solder connected parts are filled with an underfilling material which consists essentially of a one-pack type thermosetting urethane composition, the method comprising the steps of:

25 connecting said semiconductor board to said circuit board with said solder balls,

then filling the spaces between solder connected parts with said underfilling material, and

curing said underfilling material to seal said mounted board.

4. A method for producing a mounted board which comprises a circuit board and a semiconductor package holding semiconductor elements on a carrier substrate, wherein said semiconductor package is connected to said circuit board with solder balls, and spaces between solder connected parts are filled with an underfilling material which consists essentially of a one-pack type thermosetting urethane composition, the method comprising the steps of:

applying the surface of said circuit board with said underfilling material,

connecting said semiconductor board to said circuit board with said solder balls,

and curing said underfilling material to seal said mounted board.

5. An underfilling material for a semiconductor package holding semiconductor elements on a carrier substrate mounted on a circuit board, consisting essentially of a one-pack type thermosetting urethane composition.

6. The underfilling material according to claim 5, wherein said one-pack type thermosetting urethane composition comprises:

a urethane prepolymer having a terminal isocyanate group, which is obtained by reacting a polyol with an excessive amount of a polyisocyanate, and

a fine powder-coated curing agent comprising a curing agent which is in a solid state at room temperature and surface active

sites of which are covered with a fine powder.

7. The underfilling material according to claim 6, wherein said urethane prepolymer is a mixture of a urethane prepolymer having a terminal isocyanate group comprising a hydrocarbon polyol as a polyol and a urethane prepolymer having a terminal isocyanate group comprising a polyoxyalkylene polyol in a weight ratio of 9:1 to 2:8.

8. The underfilling material according to claim 6, wherein said curing agent which is in a solid state at room temperature is at least one curing agent selected from the group consisting of imidazole compounds, imidazoline compounds, amine compounds, guanidine compounds, acid anhydrides, dibasic carboxylic acid dihydrazide, guanamines, melamine and amine adducts.

9. The underfilling material according to claim 6, wherein said fine powder is one material selected from the group consisting of titanium oxide, calcium carbonate, clay, silica, zirconia, carbon, alumina, talc, polyvinyl chloride, acrylic resins, polystyrene and polyethylene.

10. The underfilling material according to claim 6, wherein said one-pack type thermosetting urethane composition further comprises at least one additive selected from the group consisting of epoxy resins, organosilicone compounds and dehydrants.

11. A method for repairing a mounted board of claim 1 comprising the steps of:

partly heating at least one of said semiconductor package and said circuit board to a temperature in the range between 180°C and 350°C,

melting said cured underfilling material and optionally

said solder,

removing said semiconductor package from said circuit board

and

mounting said semiconductor package or a new semiconductor

5 package on said circuit board.

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Fig. 1

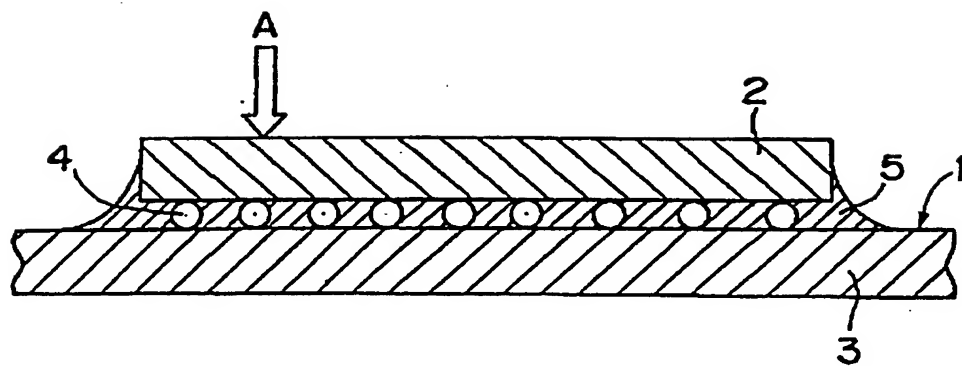
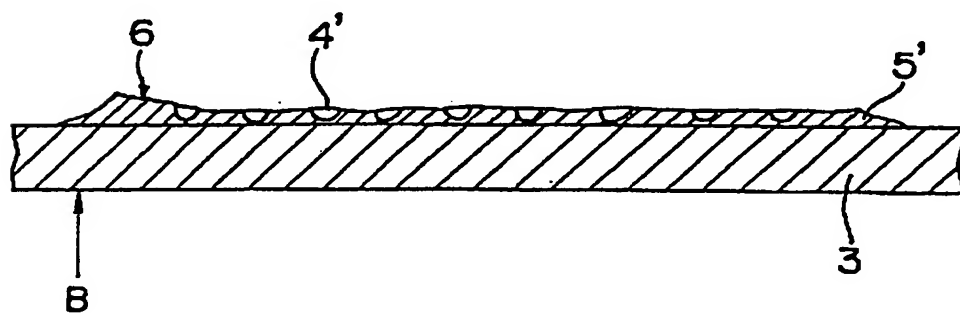


Fig. 2



INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 00/04490

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H05K3/30 H05K3/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H05K H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 31738 A (WIGHAM JON ; IIDA KAZUTOSHI (JP); LOCTITE CORP (US)) 23 July 1998 (1998-07-23) cited in the application the whole document	1-11
Y	EP 0 757 067 A (SUNSTAR ENGINEERING INC) 5 February 1997 (1997-02-05) the whole document	1-11
A	US 5 061 776 A (LONG LYNN E ET AL) 29 October 1991 (1991-10-29) the whole document	1-11
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

Inter: Application No

PCT/JP 00/04490

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>"SOLDER JOINT LIFE IMPROVEMENT USING ADHESIVE UNDER COMPONENT" RESEARCH DISCLOSURE, GB, INDUSTRIAL OPPORTUNITIES LTD. HAVANT, no. 309, 1990, page 32 XP000099320 ISSN: 0374-4353 the whole document</p>	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 00/04490

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